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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/788,889	02/27/2004	Kevin Shea	303.867US1	4555
21186 7590 01/23/2008 SCHWEGMAN, LUNDBERG & WOESSNER, P.A. P.O. BOX 2938 MINNEAPOLIS, MN 55402				
			EXAMINER SULLIVAN, CALEEN O	
			ART UNIT 1795	PAPER NUMBER
			MAIL DATE 01/23/2008	DELIVERY MODE PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/788,889

Applicant(s)

SHEA ET AL.

Examiner

Caleen O. Sullivan

Art Unit

1795

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 21 November 2007 and 26 December 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-12, 24-34 and 39-42 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-12, 24-34 and 39-42 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date 11/4/07
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

Response to Amendment

1. Applicant's amendments to claims 1, 7, 24 and 29 as well as the arguments presented have failed to overcome the rejections previously presented in the Office Action dated 8/17/07.

Therefore, Examiner restates the grounds of rejection below.

2. Applicant's amendments to claims 1, 7, 24 and 29 and the arguments presented have failed to overcome the obvious double patenting rejection of claims 1-11, 24-34 and 39-42 over copending application 11/494,056. Until a terminal disclaimer is offered the rejection of claims 1-11, 24-34 and 39-42 under non-statutory obviousness-type double patenting cannot be withdrawn; therefore, Examiner maintains the rejection below with modifications accounting for the cancellation of claims 16 and 20 in copending application 11/494,056.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.

4. Considering objective evidence present in the application indicating obviousness or nonobviousness.
5. Claims 1-4, 7-11, 24-34 and 39-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) in view of Szwejkowski ('499).

Liu ('078) teaches a method of using amorphous carbon (APF) in the etching of a substrate. Liu ('078) discloses a structure that consists of a substrate on which an amorphous carbon layer and then a layer of photoresist are deposited. (See, col.5, 15-43; Fig. 2B). The features patterned into the photoresist layer are transferred to the amorphous carbon layer by a plasma etch and then the features patterned into the amorphous carbon layer are patterned into the substrate using the carbon layer as a hard mask. (See, col.5, 15-43). This disclosure teaches the limitations of claim 1-2, 7, 9-11, 24, 29, and 39-41, where a carbon containing hard mask over a substrate with a resist is patterned, where the resist is removed, where patterning the hard mask includes patterning amorphous carbon, and where the substrate is then patterned by a dry etch method through the hard mask.

Liu ('078) also teaches the structure disclosed may include a non-carbon based dielectric layer that is deposited over the amorphous carbon layer before the photoresist layer is deposited, which can also act as an antireflective coating (ARC). (See, col. 5, 56- col. 6, 45; Fig.3A-3F). However, Liu ('078) fails to teach a process step where the surface of the substrate is treated with a solution to remove residual resist disposed in contact with the substrate under conditions that are not damaging to the underlying layers. Szwejkowski ('499) discloses a method, which teaches such process steps.

Szwejkowski ('499) discloses a method to remove sidewall residues remaining after a polysilicon layer that has been masked with a photoresist layer is etched. The residues from the etch process are removed without undercutting the remaining polysilicon, using a solution of ammonium hydroxide and peroxide. (See, col.2, 26-39 and 57-col.3, 2). This disclosure teaches the limitation of

claims 1-11, 24-29, 31-34 and 40-41 where the substrate is treated with a solution of ammonium hydroxide and peroxide to remove residual resist disposed in contact with the substrate under conditions that are not damaging to the underlying layers.

Szwejkowski ('499) also teaches the solution of aqueous hydrogen peroxide and ammonium hydroxide has a concentration ratio by volume of about 1 part hydroxide to 2 parts peroxide to .7 parts water, which is within the concentration ratio ranges recited in claims 3-4 and 10. (See, col. 3, 38-40). Moreover, this disclosure meets the limitation of claims 31-34 where the solution has a volume concentration ratio of 5:1:1 of H_2O : NH_4OH : H_2O_2 .

Szwejkowski ('499) further discloses that the solution is heated and maintained between about $50^{\circ}C$ – about $70^{\circ}C$ (See, col.3, 45-49), and the substrate is in the solution for about 5 seconds to about 15 minutes to remove the excess residue. (See, col.3, 50-57). These teachings fall within the time and temperature ranges, which are between about 2 to about 45 minutes and between about room temperature to about $70^{\circ}C$, recited in claims 7-9, 11, 26-28, 30, 34, and 41 for applying the solution of ammonium hydroxide and peroxide or a solution that is comprised of ammonium hydroxide and peroxide and other components to the substrate.

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the teachings of Liu ('078) in view of the teachings of Szwejkowski ('499) because polysilicon and carbon are in the same chemical series; therefore, it is obvious the cleaning solution and process disclosed in Szwejkowski ('499), used on a polysilicon layer can be used on a carbon layer to remove photoresist residue, while leaving the underlying layers undamaged.

6. Claims 5-6, 11, 25-29 and 31-34, are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) in view of Szwejkowski ('499) as applied to claims 1-4, 7-11, 24-34 and 39-41 in paragraph 9 above, and further in view of Chen ('435).

Liu ('078) and Szwejkowski ('499) fail to disclose solutions of ammonium hydroxide and peroxide that may include other components with a volume concentration ratio of about 100:3:2 (claims 11, 15-16, 31-34), or a volume concentration ratio that ranges from about 100:1:2 to about 100:3:2 (claim 5) or from about 100:1:1 to about 100:3:3 (claim 6), H_2O : NH_4OH : H_2O_2 . Dilute solutions of ammonium hydroxide and hydrogen peroxide, which may include other components, and are used as cleaning solutions, are disclosed in Chen ('435).

Chen ('435) discloses a method of cleaning or stripping photoresist from photomasks by using solutions of ammonium hydroxide and hydrogen peroxide. In one embodiment Chen ('435) discloses applying a very dilute solution of ammonium hydroxide and hydrogen peroxide, with volume concentration ratios of 1:2-10:200-1000 that can be simplified to a ratio of .5:1-5:100-500, at low temperatures to clean or strip photoresist from a photomask. (See, para. 0024). This disclosure meets the limitation of claims 5-6, 11, 31-34 and 42, where solutions of ammonium hydroxide and hydrogen peroxide that may also contain other components, have a volume concentration ratio of 100:3:2 (claims 11 and 31-34), or a volume concentration ratio that ranges from about 100:1:2 to about 100:3:2 (claim 5) or from about 100:1:1 to about 100:3:3 (claim 6), H_2O : NH_4OH : H_2O_2 .

Liu ('078) and Szwejkowski ('499) also fail to disclose treatment solutions of ammonium hydroxide and peroxide that may contain other components such as those recited in claims 25-29 and 33-34. Treatment solutions such as these are also taught in Chen ('435).

Chen ('435) discloses various solutions, which can be used to clean or strip resist from a photomask. One solution is comprised of an aqueous dilute solution of ammonium hydroxide and

hydrogen peroxide (dAPM). (See, para. 0024 and 0027). One solution is comprised of sulfuric acid and ozone (SOM). (See, para 0020) Both components of this solution are recited in claims 25-29 and 33-34 as components that may be included in the treatment solution. The other solution is comprised of sulfuric acid and hydrogen peroxide (SPM), which includes components that are recited in claims 25-29 and 33-34 as other components of the treatment solution. (See, para. 0034). Chen ('435) further discloses the various solutions can be combined and applied to the structure to strip or remove photoresist. (See, para. 0034 and 0043). This disclosure in Chen ('435) teaches the limitation of claims 25-29 and 33-34 where the treatment solution can be comprised of various combinations of solutions including for example aqueous solutions of ammonium hydroxide and hydrogen peroxide (dAPM) and sulfuric acid and hydrogen peroxide (SPM).

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the combination of Liu ('078) and Szejewski ('499) in view of the teachings of Chen ('435) because Chen ('435) teaches that dilute solutions of ammonium hydroxide and hydrogen peroxide, that may include other components, can be used to remove residual resist from a photomask and leave the underlying layers undamaged.

7. Claim 42 is rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) in view of Szejewski ('499) as applied to claims 1-4, 7-11, 24-34 and 39-41 in paragraph 9 above and further in view of Fang ('338).

Liu ('078) and Szejewski ('499) fail to disclose treatment solutions of sulfuric acid and citric acid that may include other components, with a volume concentration ratio range of about 100:3:2 to about 100:2:2 (claim 42), $H_2O:H_2SO_4:C_6H_8O_7$. Solutions comprised of sulfuric acid and citric acid that include other components are disclosed in Fang ('338).

Fang ('338) teaches a method to deposit a cobalt containing capping layer. As part of this process there is a pre-clean step where the substrate is exposed to a complexing agent solution to remove oxides or other residues such as organic residues, resist, and other polymeric residues from previous fabrication processes. (See, para.0028). This pre-clean step is analogous to the step where the substrate is treated with a solution to remove residual resist without damaging the underlying layers. The complexing agent is a solution that consists of at least one acid, a pH adjusting agent and other additives including citric acid and other acids such as sulfuric acid. (See, para.0029).

One exemplary complexing agent solution disclosed in Fang ('338) is comprised of water, citric acid in a concentration ratio of .05M to about 1.0M, EDTA, sulfuric acid in a concentration of .05N to about 1.0N and TMAH or ammonium in a concentration to adjust the pH to a range from about 1.5 to 10. (See, para. 0030). This disclosure meets the limitation of claim 42 where the surface treating solution is comprised of sulfuric acid and citric acid. Although Fang ('338) does not disclose the volume concentration ratio recited in claim 42, one of ordinary skill in the art would be able to determine the appropriate volume concentration ratio to achieve a solution that would remove residual resist without damaging the underlying layers.

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the combination of Liu ('078) and Szwejkowski ('499) in view of the teachings of Fang ('338), because Fang ('338) teaches that one can remove residual resist from structures such as the one disclosed in Liu ('078) with the solutions disclosed to prepare the structure for further processing without damaging the underlying layers of the structure.

Double Patenting

8. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible

harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

Claims 1-11, 24-34 and 39-42 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 13-15, 19 and 23-24 of copending Application No. 11/494,056 (US-2006/0263729). Although the conflicting claims are not identical, they are not patentably distinct from each other because the claims of copending Application No. 11/494,056 (US-2006/0263729) are broader recitations of the claims of Application No. 10/788,889.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

Response to Arguments

9. Applicant's arguments filed 11/21/07 and 12/26/07 have been fully considered but they are not persuasive.

10. Applicant argues that in the reference Liu ('078) there is no suggestion of a problem with residual resist material remaining after the removal of photoresist, and that in the Szwejkowski ('499) reference there is no suggestion that the silicon oxide film removed is photoresist. Therefore, Applicant argues that the combination of references fails to describe, or suggest the claimed features

of removing the resist; and surface treating the substrate to remove residual resist under conditions that are selective to the hard mask and to the substrate.

However, Examiner did not rely on Liu ('078) as teaching the limitation that residual resist remained after the photoresist material was stripped. The limitation of removing residual resist was taught in Szwejkowski ('499). Although, Szwejkowski ('499) does not explicitly state the polymeric silicon oxide-containing residue on the polysilicon layer is resist, it is inherent the residue includes resist material, which remains from the process where the resist layer is used as an etch mask for the underlying polysilicon layer. The residue, which contains resist material, is then removed when the structure is exposed to the hydroxide/peroxide solution. Moreover, Applicant assumes that the etching step using the resist layer as a mask removes all the resist material when used to pattern the underlying polysilicon layer, which is material known to comprise hard mask layers in semiconductor device manufacturing processes. Therefore, Examiner maintains that Liu ('078) in view of Szwejkowski ('499) does disclose, teach or suggest all the limitations of claims 1-4, 7-11, 24-34 and 39-41.

Applicant further argues that while Chen ('435) is used to demonstrate that solutions of ammonium hydroxide and peroxide are known, it does not cure the failure of the other references to suggest a surface treatment to remove residual resist material. However, as stated in the above response to Applicant's initial argument, Liu ('078) in view of Szwejkowski ('499) does teach removing resist and surface treating the substrate to remove residual resist under conditions that are selective to the hard mask and the substrate. Therefore, Liu ('078) in view of Szwejkowski ('499) and further in view of Chen ('435) does disclose, teach and/or suggest all the limitations of claims 5-6, 11, 25-29 and 31-34.

Applicant then argues that while Fang ('338) is used to demonstrate that solutions including sulfuric acid and citric acid are known, it does not cure the failure of Liu ('078) and Szwajkowski ('499) to suggest a surface treatment to remove residual resist material. However, Liu ('078) does teach a resist layer disposed over at least one ARC, and Liu ('078) in view of Szwajkowski ('499) teaches a step of surface treating the substrate to remove residual resist. Therefore, the combination of Liu ('078) and Szwajkowski ('499) modified in view of the teachings of Fang ('338) does disclose, teach and/or suggest all the limitations of claim 42.

Applicant amended claims 1, 7, 24, and 29 to include the limitation that the residual resist removed is disposed in contact with at least one of the top surface of the hardmask and the substrate; however, Examiner is of the position that the combination of Liu ('078) and Szwajkowski ('499) contemplates the limitation added by Applicant's amendment. Szwajkowski ('499) discloses a patterning process where a resist overlying a polysilicon layer which both overlie a substrate to be patterned is used to etch the underlying polysilicon layer. It is known in the art that polysilicon is a material that commonly comprises hard mask layers and this layer along with the substrate is exposed to the solution to remove the residues formed from the etching process using the resist mask. Therefore, the disclosures of Liu ('078) and Szwajkowski ('499) do teach the new limitations of claims 1, 7, 24 and 29 where residual resist that is disposed in contact with at least one of the top surface of the hard mask and the substrate is removed by performing a surface treating step.

Conclusion

11. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the

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mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Caleen O. Sullivan whose telephone number is 571-272-6569. The examiner can normally be reached Monday-Friday, 8:30am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/COS/, 1/16/08.



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